Tiny Invaders Are Shell Shocked By Researchers' Findings

The zebra mussel has become a costly visitor to the waterways near power plants.

Researchers at Old Dominion University, ODU (Norfolk, VA), have a pulsed power switch that can help solve some of the menacing problems that European zebra mussels are posing for electric utilities in 19 eastern States.

In the mid-1980s, the larvae of these unwanted mollusks hitched a ride in the ballast water of freighters carrying cargo from Europe to Lake St. Clair in the Great Lakes region. Zebra mussels have made themselves at home ever since, and are often compared to the renowned gypsy moth that invaded the eastern United States. Like the gypsy moth, these mussels have few predators and, when left unchecked, can grow to extreme numbers. They have now been sighted as far south as Baton Rouge and as far east as the Hudson River.

A BMDO PULSED POWER DEVICE OFFERS A PROMISING, NONPOLLUTING WAY TO DISCOURAGE ZEBRA MUSSELS FROM LIVING IN THE COOLING SYSTEMS OF POWER PLANTS.

Zebra mussels are inclined to live in and clog the cooling systems of power plants and ships costing utilities and shipbuilders millions of dollars to remove them. Many power plants have had to use expensive control systems that release toxic chemicals such as chlorine into the water. Most ships have no control strategies at all and may be forced to completely replace their cooling systems every few years.

Working with a pseudospark switch developed at the University of Southern California for BMDO's kinetic energy weapons, ODU has found a promising, nonpolluting way to discourage zebra mussels from residing in the cooling systems of power plants. The technology acts essentially as an electric fence, continuously applying ultrashort pulses of electricity. The pulses stun the mussels, preventing them from clinging to the surface of the cooling systems.

The pseudospark switch can also eliminate zebra mussels from the ballast water on ships. ODU is part of a consortium to develop this application through a $2 million project for the Advanced Research Project Agency's Technology Reinvestment Project. Demonstrations to eliminate or stun brine shrimp have been successful—good news, since they are considered to be hardier and therefore harder to treat than zebra mussels. The consortium, called CASRAM, includes ODU, the South Tidewater Association of Ship Repairers, the Commonwealth of Virginia, and the City of Norfolk.

ODU researchers have also developed a more accurate pulse power switch for BMDO that uses lower current and lower voltages, which can, in addition to defense, be used to treat cancer and other diseases. Still in the research stage, the switch is producing pulses that attack abnormal cells without affecting normal ones. In fact, researchers collaborated with the Eastern Virginia Medical School in a study that confirmed the ability of shorter, submicrosecond pulses to change the inside of the cell while leaving the membrane intact, which could be useful in reducing or eliminating cancerous tumors.

ODU's pseudospark switch, pictured above, acts as an electric fence, continuously applying ultra-short pulses of electricity to the plants' cooling systems.

About The Technology

The semiconductor-based pulse power switches can produce ultrashort electrical pulses of 1 million watts or more. They are made of silicon-doped gallium arsenide, which is counter-doped with copper atoms to produce a semi-insulating material of GaAs:Si:Cu. The switch is activated with a Nd:YAG laser, which energizes electrons that the copper impurities trap. The electrons remain in this energy state for several microseconds, and current flows through the switch as long as they are trapped. A second laser is used to turn off the current. Optical control of the switch allows researchers to vary the pulse duration with extremely high accuracy. The pulse duration can be as short as 100 picoseconds, making it the fastest gatable high-power switch known. These switching speeds can deliver short bursts of intense electrical power to remove zebra mussels without creating significant levels of heat.